CLAIMS

1. An optical branching unit (1) formed on a substrate, the optical branching unit comprising waveguides for guiding light at a predetermined wavelength λ, the waveguides comprising a core region having a refractive index n_{core}, the core region being embedded in a cladding (6) having a refractive index n_{clad}, the waveguides comprising an input waveguide with an input core region (2) of width w_{in} and at least two output waveguides having output core regions (301, 302) of widths $w_{out,i}$, a branching part (4) - having a refractive index n_{core} - for connecting the input and output waveguide cores, a splitting region (7) adjacent to the branching part, the width of the branching part being substantially equal to w_{in} at its joint with the input waveguide core and to the sum of the widths $w_{out,i}$ at its joint with the output waveguide cores, the width of the branching part gradually expanding from its joint with the input waveguide core to allow the output waveguide cores to be branched off and diverge from each other in the splitting region wherein a multitude of M transversal waveguide core elements (5; 501, 502, 503, 504, 505, 506, 507, 508, 509, 510) each having a width w_i, a refractive index $n_{trans,i}$ and being embedded in said cladding are located in the splitting region forming paths with a mutual centre to centre distance of s_i, said transversal waveguide core elements fully or partially connecting neighbouring output waveguide cores.

2. An optical branching unit according to claim 1 wherein opposing edges of neighbouring diverging output waveguide cores meet at the joint with the branching part in a fork or Y-type structure.

3. An optical branching unit according to claim 1 wherein said branching part comprises a tapered part joining the input and output waveguide cores, the width of the tapered part being substantially equal to w_{in} at its joint with the input waveguide core and to the sum of the widths $w_{out,i}$ at its joint with the output waveguide cores, and an abutting region, the output waveguide core regions being aligned with and extending from said tapered region and abutting each other in the abutting region.

4. An optical branching unit according to any one of claims 1-3 wherein the optical branching unit has 1 input and 2 output waveguides.

5. An optical branching unit according to any one of the preceding claims wherein the width w_i of the transversal waveguide core elements decreases with increasing i as the output waveguide cores diverge.

6. An optical branching unit according to any one of the preceding claims wherein the centre to centre distance s_i between the i'th and the (i+1)'th transversal waveguide core element increases with increasing i as the output waveguide cores diverge or run in parallel.

7. An optical branching unit according to any one of the preceding claims wherein the transversal waveguide core elements run substantially mutually parallel and perpendicular to the output direction of the optical branching unit.

8. An optical branching unit according to any one of the preceding claims, wherein at least one and preferably all of the transversal waveguide core elements form an uninterrupted path between two neighbouring output waveguide cores.

9. An optical branching unit according to any one of the preceding claims wherein the cladding (6) comprises lower (61) and upper (62) cladding layers, the core region (301) of a waveguide being formed in a layer applied to the lower cladding layer (61) supported by the substrate (10) and the upper cladding layer (62) being applied to cover the core region (301) and the lower cladding layer (61).

10. An optical branching unit according to claim 9 wherein the upper cladding layer (62) comprises boron and/or phosphorus doped silica glass deposited by plasma enhanced chemical vapour deposition as a succession of individually annealed layers.

11. An optical component comprising a combination of planar waveguides on a substrate, each waveguide comprising a core region pattern surrounded by lower and upper cladding layers, the core region pattern being formed in a layer applied to the lower cladding layer supported by the substrate and the upper cladding layer being applied to cover the core region pattern and the

lower cladding layer, the combination of waveguides comprising spaced, parallel, diverging or merging waveguide core sections wherein said component comprises a stress relieving element located in the vicinity of said spaced, parallel, diverging or merging waveguide core sections.

12. An optical component as claimed in claim 11 wherein said stress relieving element or elements is/are made of the same material and in the same process step as the core region patterns.

13. An optical component as claimed in claim 11 or 12 wherein the minimum distance between a waveguide and a stress relieving element is smaller than three times the height of the waveguide in question, such as smaller than twice the height, such as smaller than the height of the waveguide in question.

14. An optical component as claimed in any of claims 11-13 wherein a stress relieving element is elongate and has a width that is less than or equal to the width of the nearest waveguide.

15. An optical component as claimed in any of claims 11-14 comprising several parallel running stress relieving elements.

16. An optical component as claimed in claim 15 wherein the distance between neighbouring stress relieving elements is less than 15 μm, such as less than 10 μm, such as less than 5 μm.

17. An optical component as claimed in any of claims 11-13 wherein a stress relieving element has width dimensions that are larger than the nearest waveguide.

18. An optical component as claimed in claim 17 wherein a stress relieving element has a form that substantially matches the space between two merging or diverging waveguide core sections.

19. An optical component as claimed in any of claims 11-18 comprising a branching element such as a coupler or a splitter.

20. An optical component as claimed in any of claims 11-19 wherein the optical component further comprises transversal elements formed in the waveguide core layer and connecting spaced, parallel, diverging or merging waveguide core sections.

21. A method of manufacturing an optical component comprising a combination of planar waveguides on a substrate, the method comprising the steps of

a) providing a substrate,

b) forming a lower cladding layer on the substrate,

c) forming a core layer on the lower cladding layer,

d) providing a core mask comprising a core region pattern corresponding to the layout of the core regions of waveguides of the component and a pattern of stress relieving elements in the vicinity of spaced, parallel, diverging or merging waveguide core sections,

e) forming core regions and stress relieving elements using the core mask, a photolithographic and an etching process, and

f) forming an upper cladding layer to cover the core region pattern, the stress relieving elements and the lower cladding layer,

22. A method as claimed in claim 20 wherein the substrate is a silicon substrate, and the core and cladding layers comprise silica.

23. A method as claimed in claim 21 or 22 wherein the upper cladding layer has a lower flow temperature than that of the core and the lower cladding layer.

24. A method as claimed in claim 23 wherein the flow temperature of the upper cladding layer is adapted so that the waveguide core sections do not flow during an annealing that flows the upper cladding layer.

25. A method as claimed in claim 23 or 24 wherein the upper cladding layer comprises boron and/or phosphorus.

26. A method as claimed in claim 25 wherein the upper cladding layer comprises in total more than 3 weight% of boron and phosphorus such as more than 1 weight% boron and/or more than 1 weight% phosphorus.

27. A method as claimed in any of claims 21-26 wherein the formation of layers on the substrate is made by plasma enhanced chemical vapour deposition.

28. A method as claimed in any of claims 21-27 wherein the refractive index difference between the lower and upper cladding layers are less than 0,1% such as less than 0,05%, such as less than 0,01%.

29. A method as claimed in any of claims 21-28 wherein the anneal temperature is between 800 and 1200 °C, such as around 1000 °C.

30. A method as claimed in any of claims 23-29 wherein step f) comprises successive deposition and annealing steps.

31. An optical component comprising a combination of planar waveguides on a substrate, each waveguide comprising a core region pattern surrounded by lower and upper cladding layers, the core region pattern being formed in a layer applied to the lower cladding layer supported by the substrate and the upper cladding layer being applied to cover the core region pattern and the lower cladding layer, the combination of waveguides comprising spaced, parallel, diverging or merging waveguide core sections wherein said spaced, parallel, diverging or merging waveguide sections comprise segmented sections comprising a number of separate waveguide core pieces.

32. An optical component as claimed in claim 31 comprising two spaced waveguide sections forming part of an optical coupler wherein said waveguide core pieces are essentially formed as parallelograms when viewed in a planar cross section.

33. An optical component as claimed in claim 31 or 32 comprising two spaced substantially parallel waveguide sections wherein the cross sections of the two waveguide sections when viewed in a planar cross section are

mirror symmetric around an axis midway between the centre axes of the two waveguide sections.

34. An optical component as claimed in claims 31-33 wherein the spacing between each waveguide segment in a direction of intended light transmission of a waveguide section is identical for all segments.

35. An optical component as claimed in claims 32-34 wherein the angle of a parallelogram 90° + α defining a waveguide piece as defined by an edge of one waveguide section facing the other waveguide section and the first edge encountered by light propagated in the intended direction of light transmission is larger than 90°.

36. An optical component as claimed in claim 35 wherein the angle α is around 8°.

37. An optical component as claimed in any of claims 31-36 comprising transversal waveguide core elements between segmented waveguide sections.

38. An optical component as claimed in claim 37 wherein the transversal waveguide core elements of a waveguide section are angled compared to an intended direction of light transmission of the waveguide section.

39. An optical component as claimed in claim 38 wherein the transversal waveguide elements meet the corresponding waveguide segments at an angle substantially equal to 90-α.

40. An optical component as claimed in any of claims 37-39 wherein the transversal waveguide elements are segmented.

41. An optical coupler comprising a combination of planar waveguides on a substrate, each waveguide comprising a core region pattern surrounded by lower and upper cladding layers, the core region pattern being formed in a layer applied to the lower cladding layer supported by the substrate and the upper cladding layer being applied to cover the core region pattern and the

lower cladding layer, the combination of waveguides comprising a length of at least two spaced waveguide core sections wherein transversal elements are arranged between said spaced waveguide core sections, said two waveguides having - over a certain length - substantially parallel sections of waveguides that diverge from each other at both ends of the parallel sections.

42. An optical coupler as claimed in claim 41 comprising two spaced substantially parallel waveguide sections wherein the cross sections of the two waveguide sections and connecting transversal elements when viewed in a planar cross section are mirror symmetric around an axis midway between the centre axes of the two waveguide sections.

43. An optical coupler as claimed in claim 42 wherein the transversal waveguide core elements of a waveguide section are angled compared to an intended direction of light transmission of the waveguide section to minimize back-reflections.

44. An optical coupler as claimed in claim 43 wherein said spaced waveguide core sections are segmented each comprising a number of waveguide core pieces separated by a space filled with upper cladding material.

45. A method of manufacturing an optical component according to any one of claims 1 to 10 or 41 to 44_comprising a combination of planar waveguides on a substrate, the combination of waveguides comprising spaced, parallel, diverging or merging waveguide core sections forming a core region layout in a planar view, the method comprising the steps of
a) providing a substrate,
b) forming a lower cladding layer on the substrate,
c) forming a core layer on the lower cladding layer,
d) providing a core mask comprising a core pattern corresponding to the core region layout and a layout of transversal elements, the transversal elements extending between at least two of said spaced, parallel, diverging or merging waveguide core sections, thereby fully or partially connecting them,
e) forming core sections and transversal elements using said core mask, a photolithographic and an etching process, and

f) forming an upper cladding layer to cover the waveguide core sections, the transversal elements and the lower cladding layer
wherein at least one of the steps b), c), f) is performed by plasma enhanced chemical vapour deposition.

46. A method as claimed in claim 45 wherein the substrate is a silicon substrate, and the core and cladding layers comprise silica glass.

47. A method as claimed in claim 45 or 46 wherein the upper cladding layer has a lower flow temperature than that of the core and the lower cladding layer.

48. A method as claimed in claim 47 wherein the upper cladding layer comprises boron and/or phosphorus.

49. A method as claimed in any of claims 45-48 wherein all layers on the substrate are formed by plasma enhanced chemical vapour deposition.

50. A method as claimed in any of claims 47-49 wherein step f) comprises successive deposition and annealing steps.

51. A method as claimed in any of claims 45-50 wherein the waveguide core sections that are fully or partially connected by transversal elements form part of a coupler or a splitter.

52. A method as claimed in claim 51 wherein the waveguide core sections that are fully or partially connected by transversal elements run essentially parallel over a certain length of the waveguides.

53. A method as claimed in claim 51 or 52 wherein the waveguide core sections that are fully or partially connected by transversal elements essentially diverge from each other over a certain length of the waveguides.

54. A method as claimed in any of preceding claim wherein at least one of the transversal elements fully connects two waveguide core sections.